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The Right Honourable Boris Johnson
Prime Minister,
10, Downing Street
London SW1A

27 December 2021

Dear Prime Minister:

Ref: Leading scientific researchers critique the Government's Water Fluoridation Policy Paper (Health & Care Bill 2021), threat to the developing brain.

Further to our letter dated 5th September 2021, we have not yet received any acknowledgement of its receipt or any reply from your office despite it being sent by recorded delivery. We enclose a copy with this current letter and trust that you and your health advisors will respond as a matter of urgency, regarding the very serious issues we present. Sadly, we have to report that one of our co-signers, Professor Spedding Micklem, passed away in October.

As you may be aware, the Health and Care Bill 2021, is now in the House of Lords but what is very concerning is the apparent lack of thorough diligence performed by the Department of Health & Social Care (DHSC) in presenting its Policy Paper in support of mandatory water fluoridation, with its bias towards oral health and grossly inadequate review of the literature pertaining to the health risks posed by fluoridation, particularly its threat to the developing brain.

It is important to bring to your attention and that of the Health Secretary, the scientific evidence and reasoning why we believe the various references footnoted in the Policy Paper, lacked real scrutiny and failed to deal adequately or accurately with the very serious neurotoxicity studies funded by US government agencies (Bashash, 2017, 2018; Green, 2019 and Till 2020).

The whole debate on water fluoridation changed irrevocably in 2017 with the publication of a 12-year, prospective mother-child cohort study by Bashash et al. This was funded by the US Government and published in a high impact journal (Environmental Health Perspectives, published by the National Institute of Environmental Health Sciences). It showed a 4 to 5 point loss of IQ in offspring, associated with maternal fluoride intake, typical of a fluoridated community.

The results of this study were so startling it would be helpful to add some detail here. 300 mother/baby pairs were followed for 12 years. The mother's fluoride exposure was measured directly via urinary fluoride level and the paired offspring's IQ was measured (again individually) at 4 and 6-12 years of age. All the previous criticisms of the 60 or so prior cross-sectional studies, showing lowered IQ associated with fluoride, were addressed in the Bashash 2017 study. Since then, three (3) more similarly robust US Government funded studies (Bashash, 2018, Green, 2019 and Till 2020) have been published. All point in the same direction - infant IQ loss (or increased ADHD symptoms) associated with fluoride exposure at the doses experienced in artificially fluoridated communities.

It appears that the UK's four Chief Medical Officers have already concluded Water Fluoridation is safe, citing the footnoted references made in the Policy Paper. However, many of these references are either misquoted or based on outdated science and the many, newer peer-reviewed studies are either misrepresented or not referenced at all.

To raise one glaring error in the section: 'Evidence of potential harm', the Policy Paper's authors state:

“There have also been some more recent studies reporting associations between exposure to fluoride and adverse developmental neurological effects^{[footnote 18], [footnote 19]}. However, the evidence does not support this and various authoritative expert evaluations from different international organisations all agree that there is no convincing evidence that fluoride in drinking water at levels used in fluoridation schemes or at concentrations below the regulatory drinking water limit is harmful to general health^{[footnote 20], [footnote 21], [footnote 22], [footnote 23], [footnote 24]}”

However, three (3) of the five cited footnoted references [21, 23 & 24], claiming that “*the evidence does not support*” the US-funded Bashash 2017 and Green 2019 studies, were published before 2017 and thus it is absurd to use them to dismiss such important findings. Furthermore, even though the CADTH report [footnote ref. 20] was published after 2017, incredibly it did not review the Bashash 2017 study nor the Green 2019 study. The NZ Review [footnote ref 22] published in 2021, claims that these four key US government-funded studies (Bashash, 2017, 2018; Green 2019 and Till 2020) were undertaken at fluoride concentrations much higher than used in NZ (average F 0.85 ppm). That is simply not true and is an egregious error of statement.

We must, therefore, urge the DHSC and the Policy Paper's authors, to review again, these four US studies listed above. In doing so, they will find that these were either conducted in communities fluoridated at 0.7 ppm or lower (Green, 2019 and Till 2020), or, in the case of Bashash (2017 and 2018), involved pregnant women who were receiving equivalent doses to pregnant women in fluoridated communities based upon their urine levels.

Moreover, in addition to the failure of the authors of the Policy Paper to adequately review the two IQ studies that they footnote /cite, they somehow managed to miss 17 other IQ studies, finding lowered IQ in children exposed to fluoride in utero or infancy published between 2017 and 2021. A complete annotated list of all 19 IQ studies is provided in the addendum, herein.

There is also an absence of reference to many recent studies showing fluoride's association with other health effects at doses experienced in fluoridated communities. These include: Hypothyroidism (Peckham, 2015; Malin, 2018); ADHD (Malin and Till, 2015; Bashash, 2018 and Riddell, 2019); Interference with sleep patterns (Malin, 2020); Increase in biomarkers of damaged kidney function (Wei, 2021, Malin, 2019, Jiménez-Córdova, 2018), and, an increased prevalence of hip fracture in post-menopausal women (Helte et al., 2021). More details and references on these omitted studies are given in the addendum.

The Childsmile Programme

Turning to benefits, another major omission in the Policy Paper (upon which the Health and Care Bill relies for its promotion of water fluoridation) is any reference to the **Childsmile** programme (NHS Scotland) which has had very successful results without the need to fluoridate the drinking water supply. Importantly, because it focuses on the child's education, both dental hygiene and diet, Childsmile helps to reduce obesity which causes many costly

health problems. Also, because of early access to parents, it helps to fight the prevalence of baby bottle tooth decay, which often leads to operations under anaesthesia for children under 5, which is very costly for the NHS dental service.

In summary, Prime Minister, the inclusion of water fluoridation clauses in the Health and Care Bill 2021, appears to be a poorly researched endeavour, flawed in its lack of balanced scientific references within the Policy Paper, with many key studies omitted and rushed through by the DHSC.

In our view, it is essential that the clauses endorsing fluoridation be withdrawn from the Bill. Not to do so will not only cause unnecessary harm to our children and others but it will also cause your government acute embarrassment in the future. Our concerns are based on high quality science. The issue of fluoride's neurotoxicity at low doses is not going to go away – and in fact, gets stronger on a nearly monthly basis. Indeed, as we were writing this letter news came through of a new IQ study, from Indonesia, and a major review on fluoride's neurotoxicity and possible mechanism of action from the University of Cincinnati, both published within the last few days (links to these given in the addendum).

Furthermore, since the US National Toxicology Program has been engaged since 2016 in a systematic review of all the neurotoxicity studies, it would be prudent to wait for the publication of its final report, expected in early 2022, in order to aid the DHSC's anticipated and much needed reassessment of this issue. In any event, with such a major intervention proposed by the Bill, the Government needs to consider how it will warn expectant mothers and parents who bottle-feed their infants, to avoid fluoridated water, and how low-income families will be able to manage this.

Finally, over and beyond the Health and Care Bill, we urge you to put the need to protect the development of the infant brain above any further effort to promote (or protect) what appears to be a well-intended but clearly outdated practice of water fluoridation. This would not be the first time that a well-entrenched medical or dental practice has had to give way to advances in scientific understanding of unexpected and very serious side effects.

We await your reply.

Yours sincerely,

Emeritus Professor Vyvyan Howard MB. ChB. PhD. FRCPath.
Retired pathologist. Past President, International Society of Doctors for the Environment (ISDE)

Professor Paul Connett, PhD,
Retired professor of chemistry, Director of the Fluoride Action Network
www.FluorideALERT.org

- cc. The Secretary of State for Health & Social Care; the Rt Hon. Sajid Javid MP
- cc. The four UK Chief Medical Officers.
- cc. The Chair and members of The Health Select Committee.

Addendum

Herein, are further criticisms of the Water Fluoridation Policy Paper:
[Health and Care Bill: water fluoridation - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/health-and-care-bill-water-fluoridation)

1) **Policy Paper biased.**

The government's *Policy Paper, Health and Care Bill: Water fluoridation*, (Published 19 July 2021), hitherto referred to as the "Policy Paper", written to support mandatory fluoridation, is clearly biased in favour of water fluoridation and lacks balance and reference to many studies that indicate that this practice presents unacceptable health risks of ingesting fluoride.

A clear indication of the bias comes at the very beginning of the Policy Paper, where it quotes Dr. Nigel Carter of the Oral Health Foundation.

"We believe that water fluoridation is the single most effective public health measure there is for reducing oral health inequalities and tooth decay rates, especially amongst children. We welcome these proposals and believe they represent an opportunity to take a big step forward in not only improving this generation's oral health, but those for decades to come."

The predictable results of this bias in the Policy Paper are: **i.) an overestimate of the benefits** and, **ii.) a minimization of the risks to the brain**. Here are glaring examples of each:

i) Overestimate of benefits.

The 2015 'Cochrane review is cited in the Policy Paper (Ref 4) to erroneously support the statement; "authoritative bodies in England (2015)[footnote 4],, have concurred that fluoridated water confers significant dental health benefits."

In fact, this is a selective quote and misrepresents the findings of the Cochrane review. What this important review actually found was:

- a) No strong evidence that fluoridation reduced tooth decay in adults.
- b) No strong evidence that tooth decay increased when fluoridation was halted in a community, and,
- c) Contrary to claims from promoters that fluoridation helps low-income children, it found *"insufficient evidence to determine whether water fluoridation results in changes in disparities in caries levels across socio-economic status."*
http://www.cochrane.org/CD010856/ORAL_water-fluoridation-prevent-tooth-decay

While the Cochrane review found some evidence that fluoridation reduced tooth decay in children it stated that: "The available data come predominantly from studies conducted prior to 1975 . . . over 97% of the 155 studies were at a high risk of bias, which reduces the overall quality of the results."

Cochrane also questioned the relevance of these early findings noting that they were conducted before the widespread use of fluoridated toothpaste.

It should also be noted that while the Cochrane collaboration found only very meagre and questionable dental benefits of ingesting fluoride in its 2015 review, in 2013 Cochrane cited high-quality scientific evidence that topical applications of fluoride in sealants and varnish were effective.

Similar views on the Policy Paper's citation of the 2015 Cochrane Review were made to the Health Select Committee by one of its advisors, Professor Stephen Peckham, in his written submission of evidence in March 2021, where he states:

“Comprehensive and systematic reviews of water fluoridation do not support these claims and where such claims have been made they are based on inconclusive evidence and predominantly studies carried out pre 1975 – before the wide use of fluoride toothpastes (See limitations noted in the 2015 Cochrane Review and earlier 2000 NHSCRD review).”

Again, the Policy Paper’s authors have either not read the Cochrane review or have misrepresented the information therein, with a bias toward water fluoridation. This would appear to be an egregious error given that the Cochrane Collaboration is an independent organization of more than 37,000 medical and scientific volunteers in more than 130 countries. Its research is based on the principles of evidence-based medicine, and it is considered the gold standard of evaluating effectiveness.

While we have noted this overestimate of the benefits of ingesting fluoride (as opposed to topical fluoride treatments) we want to emphasize that in our professional opinion, that any discussion of dental decay is moot when we compare *any* benefits to the hugely more serious issue of life-altering fetal/infant brain damage caused by levels of fluoridation even below the levels proposed for the UK (1ppm).

ii) Minimization of risks to the brain.

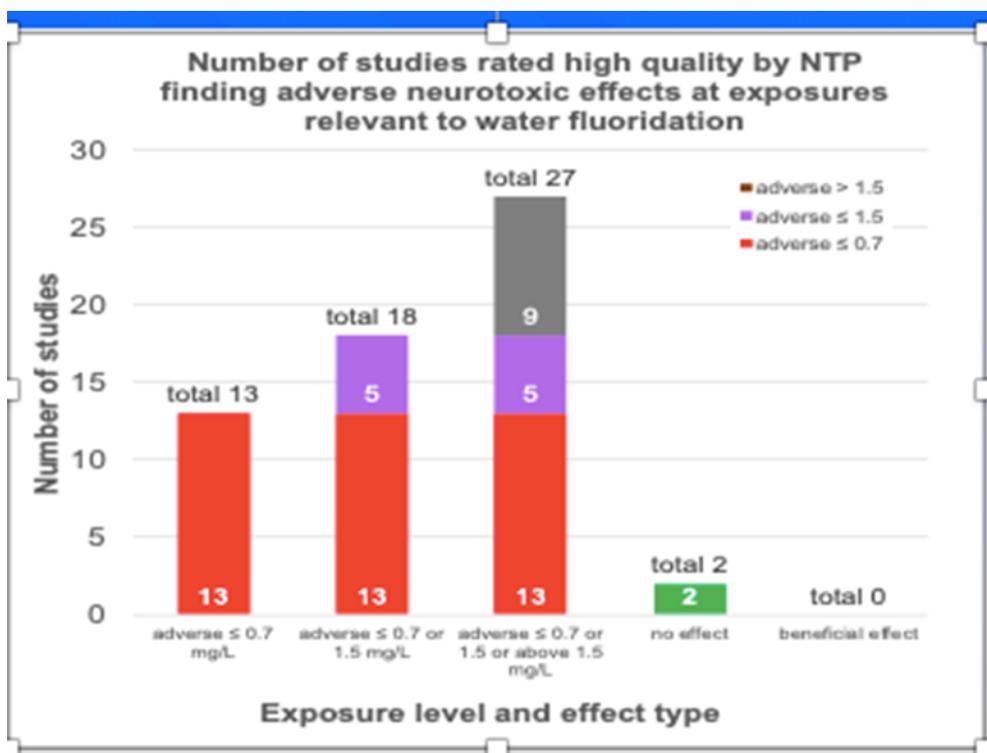
Here, we return to the selective inclusion of only the two IQ studies in the Policy Paper which was the main focus of our letter. There we stressed the grossly inaccurate dismissal of these two, US-government funded studies (Bashash, 2017 and Green, 2019).

The Policy Paper’s authors not only misrepresented these two studies, but they failed to discuss many other relevant fluoride-cognition studies. Between 2017 and 2021 nineteen fluoride-IQ studies were published in peer reviewed journals (including the four US government-funded studies discussed in our letter). We have provided a complete listing of all 19 studies below.

Furthermore, it is also odd that footnote references 18 (Bashash 2017) and 19 (Green 2019), do not have hyperlinks, while all the other referenced footnotes claiming, “*the evidence does not support*”, do, with the exception of ref 24 which is from 2015 (i.e. before 2017). This is an extraordinary mistake, given the explanation in our letter as to why these two papers are so important. We suspect that the Policy Paper’s authors did not review these two studies carefully or at all. If they had done so they could not have drawn the conclusions made in the ‘Evidence of potential harm’ paragraph, which we cite above.

Two slides’ data underline our concerns.

The data in the following two slides underline the enormity of our concerns with the Policy Paper in its dismissal of the fluoride-neurotoxicity issue based on its faulty analysis of just two of the many peer-reviewed papers available. The first slide shows a bar graph which summarizes the findings of National Toxicology Program’s systematic analysis in their draft report (NTP, 2020).



This summary was based on the work of Chris Neurath (Research Director of the Fluoride Action Network) who also used the data from the Bashash (2017) and Green (2019) studies to add to the data compiled by David Bellinger in the second slide, below. This bar graph illustrates very graphically that, today, fluoride is causing a greater loss of IQ points in the USA than any other factor including lead exposure and pre-term birth. All of the data in this second slide comes from a paper by Bellinger, except the data on fluoride which was added by Neurath.

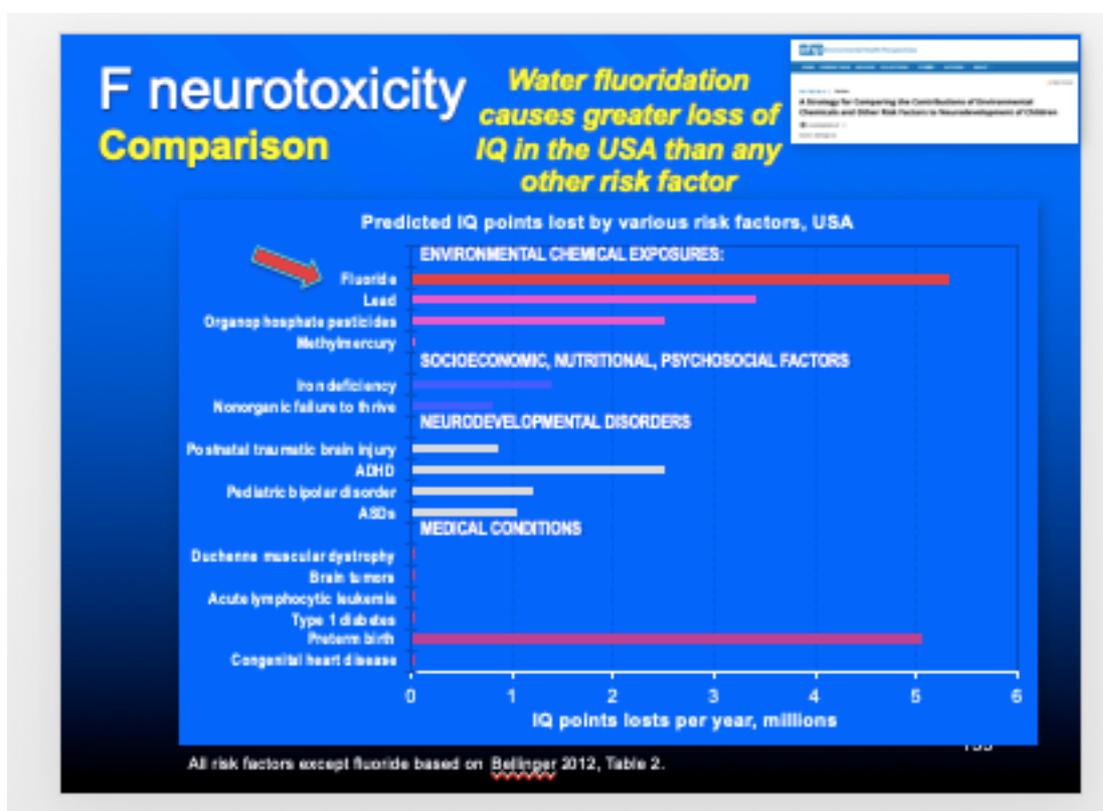


Figure: This comparison is based upon Bellinger, 2012 – the fluoride line was added by Neurath based on data from Bashash (2017) and Green (2019). Bellinger, DC. (2012) Comparing the population neurodevelopmental burdens associated with children's exposures to environmental chemicals and other risk factors. *Neurotoxicology* 33(4):641-3
https://www.researchgate.net/publication/224825235_Comparing_the_population_neurodevelopmental_burdens_associated_with_childrens_exposures_to_environmental_chemicals_and_other_risk_factors

2.) Other omissions or misrepresentations in the Policy Paper.

- a.) With regard to footnote ref. 2. World Health Organization (2017) WHO Guidelines for drinking-water quality, fourth edition and WHO 2006.

The WHO is often cited by fluoridation promoters as being in support of water fluoridation, however, such promoters never point out the important caveat that the WHO made with respect to its support. The WHO recommended that before communities fluoridated their water, they should; “first determine how much fluoride people in the area are already receiving from all possible other sources”. (World Health Organization Chronicle 23, 512, 1960). This is seldom or ever done. If it were done for the UK, in addition to fluoride from toothpaste, regulators would find that tea-drinking is another major source of fluoride. Waugh and others (Waugh et al., 2016) have investigated the levels of fluoride exposure from tea-drinking in the Republic of Ireland and one can anticipate similar exposures in the UK.

Waugh DT, Potter W, Limeback H, Godfrey M. Risk Assessment of Fluoride Intake from Tea in the Republic of Ireland and its Implications for Public Health and Water Fluoridation. *Int J Environ Res Public Health*. 2016 Mar; 13 (3): 259. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4808922/>

- b.) Omission 1; Peckham et al., 2015 study showing an increase in Hypothyroidism in fluoridated areas of the UK, is not referenced at all.

Peckham S, Lowery D, Spencer S. Are fluoride levels in drinking water associated with hypothyroidism prevalence in England? A large observational study of GP practice data and fluoride levels in drinking water. *J Epidemiol Community Health*. 24 February 2015. <https://www.ncbi.nlm.nih.gov/pubmed/25714098>

- c.) Omission 2; Malin et al. 2018, showed that among Canadian residents who had either borderline or outright iodine deficiency, exposure to fluoride made their hypothyroidism condition worse (i.e. elevated their TSH levels).

Malin AJ, Riddell J, McCague H, Till C. Fluoride exposure and thyroid function among adults living in Canada: Effect modification by iodine status. *Environment International*. December 2018; 121(Part 1): 667-674. <https://www.sciencedirect.com/science/article/pii/S016041201830833X>

Please also note a paper by Waugh (2019), which offers a possible mechanism of how fluoride might inhibit thyroid function.

Waugh DT. Fluoride Exposure Induces Inhibition of Sodium/Iodide Symporter (NIS) Contributing to Impaired Iodine Absorption and Iodine Deficiency: Molecular Mechanisms of Inhibition and Implications for Public Health. *Int. Environ. Res. Public Health* 2019, 16, 1086. <https://fluoridealert.org/wp-content/uploads/waugh-2019b.pdf>

- d.) Omission 3; A well-conducted, study from Sweden (2021) which has shown an increased prevalence of hip fracture in post-menopausal women associated with long-term exposure to natural fluoride at levels in water **in the same range as the UK fluoridates its water** [Helte et. al. 2021].

Helte E, Donat Vargas C, Kippler M, Wolk A, Michaëlsson K, Åkesson, A. Fluoride in Drinking Water, Diet, and Urine in Relation to Bone Mineral Density and Fracture Incidence in Postmenopausal Women. *Environmental Health Perspective* 2021 Apr; 129:4. <https://ehp.niehs.nih.gov/doi/10.1289/EHP7404>

- e.) Omission 4; Three recent studies (2015, 2018, 2019) indicating an association between fluoride exposure and increased prevalence of ADHD symptoms in fluoridated communities in Canada and the USA and in Mexico (where pregnant women are receiving equivalent doses of fluoride from salt).

- i) Malin AJ, Till C. Exposure to fluoridated water and attention deficit hyperactivity disorder prevalence among children and adolescents in the United States: an ecological association. *Environmental Health* 2015;14:17 <http://www.ehjournal.net/content/14/1/17/abstract>
 - ii) Bashash M, Marchand M, Hu H, Till C, Martinez-Mier EA, Sanchez BN, et al. Prenatal fluoride exposure and attention deficit hyperactivity disorder (ADHD) symptoms in children at 6-12 years of age in Mexico City. *Environ. Int.* 2018; 121 (1): 658-666. <https://www.sciencedirect.com/science/article/pii/S0160412018311814>
 - iii) Riddell JK, Malin AJ, Flora D, McCague H, Till C. Association of water fluoride and urinary fluoride concentrations with attention deficit hyperactivity disorder in Canadian youth. *Environment International*. Volume 133 (2019). <https://www.sciencedirect.com/science/article/pii/S0160412019315971?via%3Dihub>
- f.) Omission 5; Papers on the possibility that fluoride impacts kidney and liver function, even at low levels. Two papers have recently surveyed adolescents in the USA and found some associations with kidney function, and in one paper, liver function.

Wei Y, Zhu J, Wetzstein SA. Plasma and water fluoride levels and hyperuricemia among adolescents: A cross-sectional study of a nationally representative sample of the United States for 2013 – 2016. *Ecotoxicology and Environmental Safety* 208 (2021); 11670 <https://www.sciencedirect.com/science/article/pii/S0147651320315074?via%3Dihub>

Malin AJ, Lesueur C, Busgang SA, Curtin P, Wright RO, Sanders AP. Fluoride exposure and kidney and liver function among adolescents in the United States: NHANES, 2013 – 2016. *Environment International*. August 8, 2019 <https://pubmed.ncbi.nlm.nih.gov/31402058/Kidn>

Another study from Mexico indicates that biomarkers of kidney damage are observed in adults drinking water at 1.5- 2 ppm fluoride, which offers an inadequate margin of safety for a large population drinking water at 1 ppm.

Jiménez-Córdova MI, Cardenas-Gonzaleza M, Aguilar-Madrid G, et al. Evaluation of kidney injury biomarkers in an adult Mexican population environmentally exposed to fluoride and low arsenic levels. *Toxicology and Applied Pharmacology*. May 2018. <https://www.sciencedirect.com/science/article/pii/S0041008X18302382>

For those pursuing this issue a good starting point is the review by Dharmaratne published in 2019. Quoting from the abstract:

“This review covers nearly 100 years of studies on the toxicity of fluoride on human and animal kidneys. These studies reveal that there are direct adverse effects on the kidneys by excess fluoride, leading to kidney damage and dysfunction. With the exception of the pineal gland, the kidney is exposed to higher concentrations of fluoride than all other soft tissues. Therefore, exposure to higher concentrations of fluoride could contribute to kidney damage, ultimately leading to chronic kidney disease (CKD).”

Dharmaratne RW, Exploring the role of excess fluoride in chronic kidney disease: A review. *Human and Experimental Toxicology* 2019; Vol 38(3): 269-279. <https://journals.sagepub.com/doi/abs/10.1177/0960327118814161?journalCode=hetb>

- g.) Omission 6; A paper from Cunningham et al (2021), on fluoride’s impact on sleep patterns.

Cunningham JEA, McCague H, Malin AJ, Flora D, Till C. Fluoride exposure and duration and quality of sleep in a Canadian population-based sample. *Environmental Health* 2021; 20:16. <https://ehjournal.biomedcentral.com/articles/10.1186/s12940-021-00700-7>

- h.) Omission 7; The Policy Paper offers no discussion of the very successful **Childsmile** programme being conducted in Scotland. Inter alia, the Health Select Committee has been made aware of it by one of its advisors, Professor Stephen Peckham, in his written evidence submission in March 2021 where he states:

“I would suggest that if the Secretary of State was looking for ways to improve oral health then water fluoridation should not even be considered given its lack of effectiveness. More attention should be given to schemes such as ChildSmile in Scotland which has been proven to reduce inequalities, reduce admissions for tooth extractions and provide broader public health benefits beyond oral health. Such a scheme links very clearly to addressing obesity issues as well.”

- i.) Omission 8; The Policy Paper fails to acknowledge the ongoing systematic review of the neurotoxicity of fluoride by the US National Toxicology Program, in progress since 2015. Two draft reports were published in 2019 and 2020. Final report due in 2022. Needless to say, such exhaustive attention to this issue by the USA’s premier agency in toxicology, contrasts sharply with the casual dismissal of this issue by the authors of the Policy Paper.
- j.) Omission 9: The following, 19 Fluoride-IQ scientific studies, published from 2017 to 2021, report an association of fluoride exposure to lower IQ in children. These studies include 10 studies from China, 3 from Mexico, 2 from Canada, one each from Egypt, India, Kenya and Sudan.

19 Fluoride-IQ studies with annotations prepared by Ellen Connett of the Fluoride Action Network (www.FluorideALERT.org) which has tracked Fluoridation since 2000.

1. 2021- China. 709 resident children in Tianjin, China, ages 6-13. Wang S, Zhao Q, Li G, Wang M, Liu H, Yu X, Chen J, Li P, Dong L, Zhou G, Cui Y, Wang M, Liu L, Wang A. 2021. [The cholinergic system, intelligence, and dental fluorosis in school-aged children with low-to moderate fluoride exposure](#). Ecotoxicology and Environmental Safety. Conclusions: “...our findings suggest low-to-moderate fluoride exposure was associated with dysfunction of cholinergic system for children. AChE may partly mediate the prevalence of DF and lower probability of having superior and above intelligence.”
2. 2021- Mexico. 103 mother-infant pairs, tested at 12 months and 24 months. Funded by NIH & NIEHS. Cantoral A, Téllez-Rojo MM, Malin AJ, Schnaas L, Osorio-Valencia E, Mercado A, Martínez-Mier EA, Wright RO, Till C. 2021. [Dietary fluoride intake during pregnancy and neurodevelopment in toddlers: A prospective study in the progress cohort](#). NeuroToxicology. Conclusions: “In this prospective cohort study, higher exposure to fluoride from food and beverage consumption in pregnancy was associated with reduced cognitive outcome, but not with language and motor outcome in male offspring over the first two years of life.”
3. 2021 – China. 952 resident children, 7 to 13 years old. Yu X, Xia L, Zhang S, Zhou G, Li Y, Liu H, Hou C, Zhao Q, Dong L, Cui Y, Zeng Q, Wang A, Liu L. 2021. [Dietary fluoride intake during pregnancy and neurodevelopment in toddlers: A prospective study in the progress cohort](#). Environment International 155:106681. Conclusions: “Our study suggests that fluoride is inversely associated with intelligence. Moreover, the interactions of fluoride with mitochondrial function-related SNP-set, genes and pathways may also be involved in high intelligence loss.”

4. 2021 – China. 567 children, 6–11 years old. Zhao L, Yu C, Lv J, Cui Y, Wang Y, Hou C, Yu J, Guo B, Liu H, Li L. 2021. [Fluoride exposure, dopamine relative gene polymorphism and intelligence: A cross-sectional study in China](#). *Ecotoxicology and Environmental Safety* 209:111826. [Epub ahead of print]. Conclusions: “Our study examined the association between excessive fluoride exposure in prenatal and childhood periods and the intelligence of school-age children. We found that prenatal excessive fluoride exposure could cause lower IQ scores, especially the decreased odds of developing excellent intelligence. Meanwhile, a negative association between fluoride exposure and children’s IQ scores was observed in children without prenatal exposure.”
5. 2020 – China. 99 children, 8–12 years. 55 in dental fluorosis group (none with moderate or severe dental fluorosis, but all with mild) and 44 students without dental fluorosis. Lou D, Luo Y, Liu J, Zheng D, Ma R, Chen F, Yu Y, Guan Z. 2020. [Refinement Impairments of Verbal Performance Intelligent Quotient in Children Exposed to Fluoride Produced by Coal Burning](#). *Biological Trace Element Research*. Conclusions: “In conclusion, we believe that reducing fluoride intake with the assistance of the government can reduce fluorosis as well as the severity of intellectual impairment caused by fluorosis. Fluorosis in children can cause IQ impairment, especially the VIQ that is represented by language learning and vocabulary comprehension.”
6. 2020 – Canada. 398 Mother-Offspring pairs. Fetus and Infants up to 3-4 year-olds. Funded by NIEHS. Till C, Green R, Flora D, Hornung R, Martinez-Miller EA, Blazer M, Farmus L, Ayotte P, Muckle G, Lanphear B. 2020. [Fluoride exposure from infant formula and child IQ in a Canadian birth cohort](#). *Environment International* 134:105315. (Published in November 2019) Conclusions: “In summary, fluoride intake among infants younger than 6 months may exceed the tolerable upper limits if they are fed exclusively with formula reconstituted with fluoridated tap water. After adjusting for fetal exposure, we found that fluoride exposure during infancy predicts diminished non-verbal intelligence in children...”
7. 2019 – China. 571 children, ages 7-13, randomly selected from endemic and non-endemic fluorosis areas in Tianjin. Wang M, Liu L, Li H, Li Y, Liu H, Hou C, Zeng Q, Li P, Zhao Q, Dong L, Zhou G, Yu X, Liu L, Guan Q, Zhang S, Wang A. 2019. [Thyroid function, intelligence, and low-moderate fluoride exposure among Chinese school-age children](#). *Environment International* 134:105229. [Epub ahead of print]. Conclusions: The study suggests low-moderate fluoride exposure is associated with alterations in childhood thyroid function that may modify the association between fluoride and intelligence. In the current work, results demonstrated clearly that, across the full range of water and urinary fluoride concentrations and using a measure to focus on children’s IQ scores, higher fluoride levels were associated with lower IQ scores.”
8. 2019 – Canada. 512 Mother-Child pairs between the ages 3 and 4 years at testing. Funded by NIEHS. Green R, Lanphear B, Hornung R, Flora D, Martinez-Mier EA, Neufeld R, Ayotte P, Muckle G, Till C. 2019. [Association Between Maternal Fluoride Exposure During Pregnancy and IQ Scores in Offspring in Canada](#). *JAMA Pediatrics*. Conclusions: “In this study, maternal exposure to higher levels of fluoride during pregnancy was associated

with lower IQ scores in children aged 3 to 4 years. These findings indicate the possible need to reduce fluoride intake during pregnancy.” Listen to discussion of JAMA editors on their process to publish this study.

9. 2018 -China. 323 children, ages 7 – 12 years. Urine fluoride levels and age-specific IQ scores in children were measured at the enrollment. Cui Y, Zhang B, Ma J, Wang Y, Zhao L, Hou C, Yu J, Zhao Y, Zhang Z, Nie J, Gao T, Zhou G, Liu H. 2018. [Dopamine receptor D2 gene polymorphism, urine fluoride, and intelligence impairment of children in China: A school-based cross-sectional study](#). *Ecotoxicology and Environmental Safety*, Sept 11;165:270- 277. Conclusions: “Strengths of our study include using urine fluoride as an internal exposure index and thus minimizing the measurement error of exposure, adjusting up to 30 potential confounding covariates including child age and gene polymorphism in regressing IQ on urine fluoride in children, and careful modeling with applications of cross-validation, bootstrap techniques, and sensitivity analysis. “In the overall participants, by LOWESS, the IQ decreased in a roughly linear manner as the log-urine fluoride increased (Fig. 1A). “The authors also determined a safety threshold of urine fluoride on intelligence impairment in the subgroup TT as 1.73 mg/L urine fluoride with a 95% CI of (1.51 mg/L, 1.97 mg/L).”
10. 2018 – Egypt. 1,000 children, 495 children, 4.6 – 11 years old. El Sehmawy AAEW, Hammouda SM, Ibrahim GE, Barghash SS, Elamir RY. 2018. [Relationship between Drinking Water Fluoride and Intelligence Quotient in Egyptian School Children](#). *Occupational Medicine & Health Affairs*, Aug 13: 6:3. Results: “In this study there’s a highly significant decrease in average IQ level in group of children with high fluoride level more than 1.5 mg /dL than the group of children with low fluoride level less than 1.5 mg /dL with the mean IQ was (96.25 ± 19.63) and (103.11 ± 28.00) for both groups respectively with p value (p<0.001) the graphical representation of the observation is shown in Figure 2.”
11. 2018 – Kenya. 269 school children, 13-15 years Induswe B, Opinya G, Khasakhala LI, Owino R. 2018. [The Auditory Working Memory of 13-15-Year-Old Adolescents Using Water with Varying Fluoride Concentrations from Selected Public Primary Schools in North Kajiado Sub County](#). *American Journal of Medicine and Medical Sciences*, Jan; 8(0):274-290. Conclusions: “In conclusion, low fluoride in the water seemed to enhance the AWM (Auditory Working Memory). However, the AWM declined with an increase in the fluoride concentration in water.”
12. 2018 – Sudan. 775 primary students, 315 boys and 460 girls from 27 schools. Mustafa DE, Younis UM, Elhag SA. (2018). [The relationship between the fluoride levels in drinking water and the schooling performance of children in rural areas of Khartoum State, Sudan](#) (pdf). *Fluoride* 51(2):102–113. Results: “Negative correlation coefficients were found for the average score for all the subjects and for the overall score, with the result being statistically significant in five out of the eight subjects and in the overall score (Tables 4 and 5). ... significant correlations undoubtedly exist between the drinking water F level and the schooling performances in all the subjects except for one, technology, which might be due to the nature of the subject.”

13. 2018 – China. 268 children, 8 -12 years of age: 134 children each from endemic fluorosis area and non-endemic fluorosis areas. Pang H, Yu L, Lai X, Chen Q. 2018. [Relation Between Intelligence and COMT Gene Polymorphism in Children Aged 8-12 in the Endemic Fluorosis Area and Non-Endemic Fluorosis Area](#). Chinese Journal of Control of Endemic Diseases 32(2):151-152. Study in Chinese translated into English. Conclusions: “This study found that there was a great difference in the level of intelligence between children in the endemic fluorosis area and those in the non-endemic fluorosis area and such difference was statistically significant ($P < 0.05$). “The rate of mental retardation (IQ < 69) in children in the endemic fluorosis area was significantly higher than that in the non-endemic fluorosis area, and the difference was statistically significant ($P < 0.05$).”
14. 2018 –China. 2,886 resident children, 7 to 13 years. Yu X, Chen J, Li Y, Liu H, et al. (2018). [Threshold effects of moderately excessive fluoride exposure on children’s health: A potential association between dental fluorosis and loss of excellent intelligence](#). Environment International, Jun 2; 118:116-124. Conclusions: “In conclusion, chronic exposure to excessive fluoride, even at a moderate level, was inversely associated with children’s dental health and intelligence scores, especially excellent intelligence performance, with threshold and saturation effects observed in the dose-response relationships. Additionally, DF severity is positively associated with the loss of high intelligence, and may be useful for the identification of individuals with the loss of excellent intelligence.”
15. 2017 -Mexico. 299 Mother–Offspring pairs. Tests at age 4 and 6–12 years. Funding from NIH, NIEHS, and EPA. Bashash M, Thomas D, Hu H, Martinez-Mier EA, Sanchez BN, Basu N, Peterson KE, Ettinger AS, Wright R, Zhang Z, Liu Y, Schnaas L, Mercado-García A, Téllez-Rojo MM, Hernández-Avila M. 2017. [Prenatal Fluoride Exposure and Cognitive Outcomes in Children at 4 and 6–12 Years of Age in Mexico](#). Environmental Health Perspectives, Sept 19;125(9):097017. Conclusions: “In this study, higher prenatal fluoride exposure, in the general range of exposures reported for other general population samples of pregnant women and nonpregnant adults, was associated with lower scores on tests of cognitive function in the offspring at age 4 and 6–12 y.”
16. 2017 Mexico. 65 Mother-Offspring infant pairs, aged 3–15 months, in an endemic hydrofluorosis area. Valdez Jiménez L, López Guzmán OD, Cervantes Flores M, Costilla-Salazar R, Calderón Hernández J, Alcaraz Contreras Y, Rocha-Amador DO. 2017. [In utero exposure to fluoride and cognitive development delay in infants](#). Neurotoxicology Mar;59:65-70. Results: “In this study near to 60% of the children consumed contaminated water and the prevalence of children with IQ below 90 points was 25% in the control group (F urine 1.5 mg/g creatinine) in comparison with the 58% of children in the exposed group (F urine >5 mg/g creatinine) (OR = 4.1, CI 95% 1.3–13.2) (data unpublished). “Only 66.2% of the babies were at term. “We found higher levels of F in urine across trimester in premature compared with full term 2.4 vs 1.6 mg/l (1st); 2.3 vs 1.8 mg/l (2nd); and 4.1 vs 2.8 mg/l (3rd) (data not shown).”
17. 2017 – China. 118 newborns, 68 newborns to 12 months of age, from coal-burning fluorosis areas. Chang A, Shi Y, Sun H, Zhang L. 2017. [Analysis on the Effect of Coal-Burning Fluorosis on the Physical Development and Intelligence Development of](#)

[Newborns Delivered by Pregnant Women with CoalBurning Fluorosis](#). Chinese Journal of Control of Endemic Diseases, 32(8):872-873. Conclusions: "Comparison of the mental development index (MDI) and psychomotor development index (PDI) (assessed using the Standardized Scale for the Intelligence Development of Children formulated by the Children Development Center of China [CDCC]) of newborns in the two groups at 3, 6, 9 and 12 months after birth showed that both the MDI and the PDI in the observation group were significantly lower than those in the control group ($P < 0.05$), which suggests that maternal fluorosis have a significant impact on the intelligence development of newborns."

18. 2017 -China. 284 children, 8 – 12 years: 167 were from coal burning-related endemic fluorosis areas and 117 were the control. Jin T, Wang Z, Wei Y, Wu Y, Han T, Zhang H. (2017). [Investigation of Intelligence Levels of Children of 8 to 12 Years of Age in Coal Burning-Related Endemic Fluorosis Areas](#). Journal of Environment and Health 34(3):229-231. Conclusions: "The intelligence of the 12-year-old group in the endemic area was lower than that of the control area, with the difference having statistical significance ($Z = 3.244$, $P = 0.001$)."
19. 2017 – India. 219 children, 12-14 year olds: 75 from low F area, 75 medium F area, and 69 from high F area. Razdan P, Patthi B, Kumar JK, Agnihotri N, Chaudhan P, Prasad M. (2017). [Effect of fluoride concentration in drinking water on intelligence quotient of 12–14-year-old children in Mathura District: A cross-sectional study](#). Journal of International Society of Preventive & Community Dentistry 7(5):252- 258. Conclusions: "Concentration of Fluoride in the ingested water was significantly associated with the IQ of children. Outcome measures revealed that exposure to higher levels of F determined by dental fluorosis status of child inferred higher IQ deficit."

Two further recent fluoride neurotoxicity IQ cognition studies. December 2021.

1. The influence of fluoride in drinking water on the incidence of fluorosis and intelligence of elementary school students in Palu City. <https://www.sciencedirect.com/science/article/pii/S0213911121001965?via%3Dihub>
2. Impacts of Fluoride Neurotoxicity and Mitochondrial Dysfunction on Cognition and Mental Health: A Literature Review. <https://pubmed.ncbi.nlm.nih.gov/34948493/>